

This paper describes the use of the Office Analysis Methodology to study a research office environment in order to determine requirements for an advanced office workstation. The research site environment is unique in providing an opportunity to observe a natural growth pattern in the use of advanced technology. Specific workstation requirements are identified and are being implemented. Interesting observations are reported in the following areas: categories of secretarial work, use of existing workstations, influence of a community of users, access to shared services, and effects on productivity and organizational behavior.

A case study of office workstation use

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In the spring of 1981 the authors decided to study an operational problem at the IBM San Jose Research Laboratory. A variety of typewriters and terminal equipment installed in offices throughout the Laboratory had been acquired over a period of time for use by administrative and secretarial workers. As part of planning for an expansion of physical facilities, a committee compiled an inventory of this equipment. Those on the committee recognized the need to understand how the equipment was actually used if they were to make intelligent recommendations about what equipment should be provided for the secretarial and administrative support staff in the future.

At the same time, the computer science group within the Laboratory was designing an advanced workstation for eventual introduction in the office workplace. It became clear that a study of the work patterns of the administrative support staff in this particular Laboratory could be helpful in understanding the general requirements for an advanced office workstation.

After reviewing published methodologies, the decision was made to study the operational problem jointly with the Massachusetts Institute of Technology Center for Information Systems Research. The Center had been in the process of conducting research into the nature

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of office work using a procedure developed at MIT¹ and known as the Office Analysis Methodology (OAM). Research at the Center had been designed to explore office automation issues in several types of organizations, including those typical of manufacturing, high-technology, and service industries.

As Zisman² observes, much of the previous work directed toward office automation has focused on mechanization of the current straightforward paper-producing tasks. The studies, conducted as part of the Center's research on office automation, encompass the total range of procedures carried out by office workers at all levels—from secretarial to executive. The studies seek to identify, through interviews during site visits, procedures that are critical to the mission of offices within organizations. When the procedures are outlined and related to the mission of an organization, those critical procedures and tasks that would benefit most from computer-based technology can be identified.

We present here the results of one part of the Center's study conducted at the San Jose Research Laboratory. This part focuses on existing secretarial tasks performed using existing workstations. The results of the study were used to develop requirements for office workstations for the Laboratory. Although the results presented here are from a single case study, they do indicate the value of using a systematic methodology, such as the Office Analysis Methodology, to study office work. From our study of office environments similar to that found at the Laboratory, we believe that the requirements apply generally to office workstations in other highly automated offices.

Method

objectives

We chose the following two objectives for the first phase of the specific study at the San Jose Research Laboratory:

- Survey the tasks currently performed by the secretarial staff.
- Understand the current use of the existing workstations and the role that they play in support of these secretarial tasks.

The objectives of the study were focused initially on answering the short-range operational question of workstation requirements and selection. Interviews were directed toward understanding the existing procedures and the possible effects arising from the acquisition and installation of new office workstations.

Although we looked for procedures and tasks that could benefit from additional automated aids, that was not a main focus. The difficult tasks of measuring productivity and predicting the effect of change on the organization were not central in considering what equipment

would be needed to support existing work. In the course of the interviews, however, factors that affect productivity and organizational behavior were observed.

The Office Analysis Methodology (OAM) was used to guide and structure the study, with focus on the following: (1) understanding the operation of each office within the organization with respect to the overall organizational mission, and (2) understanding how that mission is accomplished. This focus involves conducting a functional analysis of the office operation expressed in business terms. The procedures being performed and their purposes are identified so that analysts, programmers, and office workers can communicate effectively about requirements.

Office Analysis Methodology

The Office Analysis Methodology defines several levels of abstraction as a conceptual framework for gathering data. The *mission* of an office support group (primarily, the secretarial staff) is described in terms of purpose and goal (e.g., support of the technical staff by preparing documents, handling telephones, and managing office work). A *function* (e.g., document preparation) is the aggregate of all the procedures that *initiate*, *manage*, and *terminate* the use of office resources to achieve a business goal such as keying, proofreading, printing for review, and revising text. A *resource* is an entity, such as a document or a word processor, that is managed to meet a business goal. A *procedure* (e.g., an outline of the sequence for printing a photo-composed draft) prescribes the tasks needed to complete an activity. A procedure (or the tasks specified within a procedure) often involves the manipulation of a specific *object* or set of objects. An *object* is a tangible entity that is a component of a resource or that provides information about the resource. Typical objects are a typed page or an instruction book.

The Office Analysis Methodology offers potential benefits by avoiding the following pitfalls often encountered in the use of conventional requirements analysis:

- Suboptimizing present procedures as a result of a focus on discrete procedures and tasks taken out of context.
- Preserving archaic procedures as a result of a concentration on mechanizing a discrete process without gaining an understanding of the bigger picture.

In addition, the Office Analysis Methodology provides the opportunity to identify those activities that are valuable in accomplishing the mission, as opposed to identifying only the easily observable, visible, structured tasks. Through this approach, the Office Analysis Methodology can help to define productivity and isolate useful measures that apply to semistructured tasks found in the office, the work as it is actually carried out.³

Table 1 Comparison and contrast between two methods of office requirements analysis

<i>Conventional requirements analysis</i>	<i>Office Analysis Methodology</i>
Look for processes sufficiently structured to be completely automatable	Focus on requirements of functions within the organization (not on operational details)
Concern with specific procedures instead of functions	Orientation around functions and resources that are then supported in procedures
Look for a single system approach	Functions can be supported by a variety of procedures or alternative system approaches
Little attention to behavioral and managerial aspects of system design	Concern for decision-making role of office staff at all levels
Focus on the need for change and the technology that can be applied to this end at lower organizational levels	Concern with organizational needs of client group at all levels
Secretarial time spent typing	Number of hours by number of people required to complete a procedure; times per week the procedure is repeated; number of procedures in process at any time
Number of forms filled out per unit of time	Number of resources in process per unit of time to carry out a business function

The Office Analysis Methodology is intended to be quite comprehensive. It can be used for descriptive studies, such as how work is now done in an office; or it can be used for prescriptive studies such as how new procedures can be used to better carry out the function of an organization. This methodology includes what to do in a study, recommends interview procedures, and outlines analyst qualities needed. It suggests concentration on the usual path through a process followed by analysis of exceptions and how they are handled.

The best available description of the Office Analysis Methodology is given in Reference 1. We can give only an outline of the concept here. Table 1 summarizes a comparison and contrast between conventional requirements analysis and the Office Analysis Methodology. This table is not meant to be a comprehensive comparison inasmuch as it highlights only some key differences.

We began preparing for our study at the San Jose Research Laboratory by adapting an interview outline previously developed for use as part of the CISR study at other sites. The interview outline is summarized in Table 2.

Table 2 Interview outline

I.	<i>Mission/function:</i> Mission statement; organization chart
II.	<i>Resources</i>
	A. People (who, how many, management levels)
	B. Other resources
III.	<i>Major tasks/procedures</i>
	A. Phases (initiating, managing, terminating)
	B. Inputs/outputs
	C. Sources, destinations, links
	D. Exceptions (checklist of exception causes provided)
	E. Objects (checklist of sample objects provided)
	F. Data bases (checklist of sample manual and electronic data bases provided)
	G. Quantitative measures
	1. Number of objects in process at any time
	2. Time to accomplish a task
	3. Time to accomplish a procedure (set of tasks)
	4. Frequency of repetition
	5. Number of objects processed per unit of time
	6. Timing constraints on completion of a task
	7. Frequency of exceptions
	8. Number of people involved in each step of a procedure
	9. Size of data bases
	H. Office layout/environment
	1. Equipment (what, what used for, likes and dislikes)
	2. Comfort, style
	3. Training
	4. Special needs

The IBM San Jose Research Laboratory is organized into the following four major research areas, called *functions*, each of which is headed by a functional manager who reports to the Director of the Laboratory: Computer Science, Physical Science, Storage Systems, and Applied Science. Although the use of the term "function" is not identical to the use of the term in the Office Analysis Methodology, both uses relate to a focus on activities needed to achieve mission results. All centralized administrative tasks are combined at a functional level known as Administrative and Technical Services. The total population numbers about six hundred research and support personnel.

Within each research function there are two to three departments ranging in size from 23 to 45 persons. Those who do research have the title Research Staff Member; they are grouped by research specialty within the departments and assigned to specific projects. Although the research staff is relatively stable, shifting between departments and projects is quite common. In addition, a number of visiting scientists, postdoctoral fellows, and summer interns report at functional, departmental, or project levels while temporarily at the Laboratory.

**organization
of the
study
site**

Table 3 Organizational analysis of secretaries interviewed

<i>Organizational level served</i>	<i>Number of secretaries interviewed</i>	<i>Range of people served by each secretary</i>
Functional manager	4	3-7
Department manager	9	23-43
Administrative/other	8	5-45
Total	21	

In this phase of the study, we confined our interviews to the secretarial staff working at the function and departmental levels. We also included those secretaries working in the Administrative Processing Center giving support to professionals in the Administrative and Technical Services function.

The Laboratory provided an intriguing research site. Whereas it is comparable to our other research sites in its basic organizational design and its administrative functions, it is unique in the following ways. First, the Laboratory is staffed by technically oriented, highly skilled professionals who create an environment that is receptive to introduction of new technology. This is expected in any group working on advanced technology products. The innovative attitudes of the Research Staff Members are also exhibited in their experimentation with new technology in their routine office activities—drafting papers, preparing presentations, and sending messages to colleagues. In addition, sophisticated technology is available to administrative people in a setting that is without requirement or formal pressure to use it. This, combined with the supportive access to information from Research Staff Members, results in an unusual opportunity for studying natural growth patterns in the use of advanced technology. Thus, we could observe actual patterns of use in a technologically sophisticated environment, as contrasted with the speculations often discussed by writers on the “office of the future.”

We used the Office Analysis Methodology framework to construct a one-hour interview. The selection of those to be interviewed and the range estimate for the numbers of people served by them were made from an inspection of the organization chart. The categories of those interviewed and the range of people nominally served by each secretary in the category are summarized in Table 3.

Each secretary was interviewed at the place of work where sample objects (computer-readable and paper copy) could be displayed as needed for illustration. All secretaries interviewed used a desk-top terminal capable of displaying simultaneously on the screen 24 lines of 80 upper- and lower-case characters. Some secretaries had a

Table 4 Categorization of secretarial work

<i>Work initiated by others</i>
• Secretary is told explicitly what to do (e.g., given raw text and a sample letter specifying the format)
• Secretary is given some discretion (e.g., foil format)
<i>Work initiated by secretaries</i>
• When told (in a general sense) to achieve a result (e.g., produce an equipment inventory list)
• When told they are responsible for a result (e.g., making mailing labels)
• When observing a need and taking responsibility for meeting it (e.g., monitoring department expenditures)

terminal allowing the display of 43 lines at a time. Each terminal had an attached (but movable) keyboard. In addition, each secretary or administrative support person had a communicating typewriter terminal for printing output on letterhead paper. This terminal, which had magnetic card storage, was also used occasionally as a stand-alone typewriter.

The display terminals, which had no stand-alone data entry capability, were attached to a large-scale host computer operating the VM/CMS system. Also attached to the computer, both directly and through a network, were many high-speed and/or high-quality printing devices used to produce output on a variety of paper and preprinted forms. The network links computers in most IBM laboratories worldwide. The secretaries in the study sample were using a variety of software available on the system, including a full-screen editor, a document formatting and printing facility, a message system, and a number of locally developed macro programs.

Interview results

In our study, we focused on resources and objects that resulted in paper copy or that went through a keyboard data-entry phase. We did not address telephone handling as a task (except to note approximate percentages of time spent), although we did consider typed lists as support for making telephone calls.

**types
of
tasks**

The secretarial work at the San Jose Research Laboratory can be divided into the two categories shown in Table 4. In the first category, the "others" who initiate secretarial work are professionals, managers, and visitors serving on the staff. The category of "work initiated by others" is the one that generally comes to mind when people describe the work of the typical (or perhaps stereotypical) secretary. This work is text-oriented, wherein the initiator provides text (handwritten, dictated, rough-typed), and the secretary provides text output in typewritten or printed form. Completion requires little contact with other resources, either documents or people. These tasks

Table 5 Tasks initiated by others to which a secretary may add value and creativity

<i>Form</i>	<i>Form and content</i>
Typing letters	Memoranda announcing meetings
Technical typing (e.g., formulas, equations, special characters)	Applicant handling
Foil layouts	Speaker announcements
	Shaping notes into sentences and paragraphs
Activity reports	Budgets
Progress reports	Space planning, moves, and telephone assignments
Proposals	New staff, visiting professionals, summer interns; orientation and records
Performance plans	Equipment inventory
Research orders	

require a fixed format that has been standardized through policy, tradition, or equipment constraints. The outputs are typically a file specifically designed to be revisable (because the final task result is subject to initiator negotiation) and text-on-paper for initiator review. Examples are notices, letters, memoranda (relatively short), and activity reports (relatively long). In the second category, the levels of self-initiated work reflect increased responsibility and creativity. Although this category involves keyboard data entry, the data entry is not an end in itself. Completion generally requires contact with others, and the secretary has flexibility in selecting the format in which the results are presented. The outputs are typically files used by the secretary in carrying out office procedures. Examples are mail logs and reminder files.

There seem to be a series of prerequisites for secretarial work to begin appearing in the self-initiated category. First, powerful tools (or a light work load) must make it possible to accomplish routine work. Also the secretary must have a willingness to explore the use of tools in imaginative ways. And the professionals served must acknowledge the value of the resulting innovation.

Hiltz and Turoff⁴ describe the category of "work initiated by others" well when they observe that secretaries act as intermediaries between the originators and the recipients of text. The authors comment that word processors are typically aimed at one specialized aspect of what the secretary actually does.

There are other non-text kinds of work in the initiated-by-others category, such as the placing of telephone calls. The extent to which a secretary can influence the process used to complete such tasks depends on the precision with which the order is given. The initiator may fully describe the task (e.g., specify the exact format) or may leave that to the discretion of the secretary. An instance of the

secretary's adding value to the output is in the design of overhead projector foils. In this category, there are two breakdowns: (1) tasks in which the added value is in form only, and (2) tasks in which both form and content are influenced by the secretary. Table 5 lists examples of both ways of adding value to tasks.

Tasks initiated by secretaries in order to better accomplish a job involve a flexible format. Examples include equipment inventory, personal calendars, and budgets. The self-initiated work listed in Table 6 includes the use of keyboard tools and requires the secretary to do considerable thinking. That is, the secretary must add value in order to achieve the result. Of course, many non-keyboard tasks could also be found in this category when observing a secretary at work (e.g., telephone calling, setting up meetings, planning office moves, and acquiring furniture and equipment).

A major result of our interviews is the observation of how time is allocated among categories of work. Secretaries to function managers spend less than 50 percent of their time doing structured text entry initiated by others. Secretaries to department managers spend from 50 percent to 90 percent of their time doing such work, depending on the style of the department and the style of the individual secretary. The remaining secretaries spend 75 percent to 95 percent of their time on this category of tasks. The time estimates were collected during the interviews and reflect the judgments of those who were interviewed. Although the figures were not independently validated, the results are consistent within the hierarchy of secretaries, suggesting that these approximations are reasonable. The interview results were supplemented by some direct observation.

It is clear that much of the secretarial workload consists of tasks initiated by the secretary, contrary to the conventional stereotype that secretaries carry out only highly structured tasks at the direction of the persons supported. We found that secretaries to function managers typically spend more than half their time working on self-initiated tasks, and department secretaries spend from 10 percent to 50 percent of their time in such activities.

In the previous discussion of types of tasks, the variety of documents at the Laboratory was also illustrated. Tables 4, 5, and 6 list examples of the documents identified in the course of the study. Because document preparation, storage, retrieval, and printing are major office workstation tasks, we used the Office Analysis Methodology concept of "objects" to investigate document entry into the Laboratory secretarial work flow. We classified documents on the basis of frequency as seen by the secretary. Table 7 shows this classification with another sample of documents—preprinted forms—listed in each frequency category. The study identified over fifty different documents, in terms of format, about equally divided among the three classes. Document preparation can be either self-initiated or initiated

Table 6 Self-initiated tasks involving form and content to improve performance

Mail log
Distribution lists for reports and memoranda
Equipment inventory
Employees' home addresses and telephone numbers
Mail forwarding lists and labels
Reminder file based on data
Financial monitoring to track budget expenses

**pattern
of
time
allocation**

**nature
of the
documents**

Table 7 Example documents and their frequency of use

<i>High activity</i>	<i>Medium activity</i>	<i>Low activity</i>
Travel expense authorization	Invention disclosure	Work authorization order
Purchase order	Presentation clearance	Award
Check request	Request for publication	Patent administration
Petty cash	Foreign travel approval	Verification of foreign seminar attendance
Time card	Personnel data	
Travel plan	Ordering manuals	
Manuscript processing center work order		

Table 8 Preferences for use of display terminal and for typewriter terminal

- 90% preferred the use of a display terminal at all times unless:
Slow response time observed due to heavy host usage.
Special letterhead needed on short notice.
Host service observed to be temporarily unavailable.
- 100% preferred typewriter terminal for:
Filling out forms.
Short, one-time jobs.
- 14% preferred using typewriter terminal for confidential or sensitive text.
- 48% preferred to input confidential or sensitive text on the display terminal and print on a host-connected typewriter terminal.
- 38% did not work with confidential or sensitive text.

by others, but it is low on the value-added scale. However, document preparation may be a task associated with a much more significant procedure, such as planning for and ordering new office equipment, that may be important to the mission of an office.

use of existing workstations

Each secretary has access to a display terminal that is connected to the host computer and to a communicating typewriter terminal with printer and magnetic card storage. We inquired into secretarial preferences for choice of terminal and the criteria entering into the decision. We expected that these preferences would illustrate characteristics of work style or features deemed useful by the secretaries. The results of the inquiry are shown in Table 8.

To explore these preferences further, we asked the secretarial staff for their opinions about the characteristics they liked when using a display terminal. These characteristics are listed in Table 9. Note that these are really opinions about the display terminal and the services accessed via these terminals. In summary, assuming the host system was delivering normal service, the display terminal was

Table 9 Characteristics of work well-supported at display terminals

• Ease of manipulation and correction of text
• Establishment of standard format for selves and others
• Communication features
Messages
Transmission of text files to any location with a proper terminal connected to the network
• Special printing features
Fonts containing special characters, highlighting
Graphics
Photo-printers providing book text quality
• Access to special features programmed on the host

always preferred except when there were printing constraints, such as a special letterhead, addressing a single envelope, or personal and confidential text.

These opinions reflect two presuppositions, those of productivity enhancement and expectations for text output quality. The secretaries unanimously felt that the ease with which text could be manipulated and changed on the display terminal was a major aid in supporting their ability to produce results. The message and text transmission features saved time and footsteps. These features also provided support communications among secretarial and research staffs that were never before possible when Research Staff Members were working at home or at other IBM locations.

Changes in staff expectations is an interesting finding of our study. As soon as secretaries began experimenting with sophisticated printing options for both reports and foils, the research staff came to expect the high quality as a matter of course.

As a result of their extensive use of the display-terminal and host-based features, the secretaries made a number of observations concerning things they would like to see changed. Of greatest concern was the lack of formal training. They recalled their first days using the system with some sense of accomplishment, but they did not think it was an efficient way to learn. They also were frustrated in that they suspected the system contained a number of additional features that they would find valuable, but they had no easy way to confirm this. The observations are summarized in Table 10.

The Laboratory research staff make extensive use of the VM/CMS system and the display terminals for administrative as well as technical support. The Research Staff Members in the Computer Science function, in particular, have an understanding of the underly-

**community
of
users**

Table 10 Characteristics of work with display terminal that secretaries would like changed

-
- Lack of organized training:
 - Re-creating formats that already exist.
 - No formal way to learn reliably of new features.
 - Poor documentation of host programs.
 - Learning curve longer than necessary.
 - Host unavailability; slow response time.
 - Printer problems:
 - Located several hundred feet from the secretarial work area.
 - Not safe to send personal and confidential text to a semipublic output area.
 - Schedule for loading special letterhead paper stock too restrictive.
 - Printers relatively close to work area did not have subscript and superscript capability.
 - Difficult to proofread text displayed on a vertical display screen.
 - Terminal physically cumbersome; requires too much desk top area; too massive; too heavy to move conveniently.
-

ing system organization, a professional interest in adding new capability to the system, and a personal interest in seeing this new function used. These combine to act as a powerful influence for innovation in carrying out secretarial and administrative work.

For example, an individual staff member may develop a new way to use the computer, such as creating a SHIP macro command for transferring files between local users and over a network. That person may then tell or show colleagues how the new command makes their job easier. Some colleagues typically discover additional things that can be done, and add those functions to the system. Since staff members are accustomed to doing much of their own secretarial work because the tools to do this have been provided, they often discover new ways of using the system for office activities. (Investigation of Research Staff Member work is another part of our study, but that is not presented here.) Staff members, in the course of enlisting secretarial support for a task, explain the use of the system to do a particular job. A secretary, typically receptive to a new idea, makes notes on the use of that feature. Then at lunch, or in the course of an exchange with another secretary, the technique is passed on. The readiness to accept innovation, coupled with an easily used message system, leads to the spread of such information over the informal network.

Note that this process can operate two ways. Ideas that seem at first to be good may upon wider use be discovered to be flawed. For example, a RECEIVE macro command allows incoming files to overwrite user files that happen to have the same name. The word soon spreads to watch out, and many users begin using a similar but

accident-proof RD (for "read") macro command instead. Thus, the Laboratory environment tends to separate the unworkable from the workable.

A variety of services available on the host computer can be accessed by the secretaries through the terminal. Table 11 shows examples of these services.

The secretaries consider a computer-based message system that is available to be an important aid in doing their work. They use the facility to exchange brief notes, to seek help on special problems in system use, and to exchange techniques by sending special formats to one another. There appears to be a significant use of this message system in preference to use of the telephone. Although the telephone is an instrument for direct and immediate conversation, one is aware of the disruptive nature of a telephone call. By using the message system, the exchange can be managed by the recipient on a when-convenient basis, whereas conventional office etiquette requires that a ringing telephone be answered. Computer messages can be duly noted without interrupting the flow of the work in progress.

Messages on the current system are used in two modes. In a direct mode, the name of the recipient and the content of a short message (100 characters) are specified simultaneously. The message can be delivered only when both parties are on-line at the same time. This mode is useful for brief notes where immediacy of exchange is important. No record of these messages is kept on the system. A second mode allows a message to be stored for later reading if the recipient is not currently using the system. If the recipient is on-line, a notice appears interspersed with whatever work is in progress. The notice states the source but not the content of the message. The secretary can then access and read the message when convenient via a set of commands.

Interpretation of results

The primary objective for this part of the CISR Office Analysis Methodology study at the San Jose Research Laboratory was to help determine the requirements for administrative workstations. As previously mentioned, all secretaries in the study had dual workstations (display terminal and communicating magnetic-card typewriters). This dual-workstation configuration was expensive, occupied about fifteen cubic feet, and required an entire desk top surface area. In addition, much of the equipment was reaching the end of its useful lifetime, and many terminals had noise and maintenance problems. Thus the Laboratory administrative management was interested in replacing these workstations. The management and many secretaries were aware of CRT word processors and were interested in their possibilities for use at the Laboratory.

shared services

Table 11 Computer-based support for routine activities

Looking up numbers in an on-line telephone directory
Checking spelling of text documents
Calculating using on-line hand calculator function
Using clock in connection with a reminder file
Sending and receiving soft copy documents and messages

requirements for office workstations

Table 12 Study results indicating administrative workstation requirements

<i>Study results</i>	<i>Related requirement</i>
• Dependency on host services; community of users. • Magnetic card typewriter for short documents, backup, and printing. • Dual workstations used at the same time.	• Host attachment with terminal emulation and file transfer. • Typewriter emulation and high-quality printer.
• Wide variety of documents.	• Multitasking with simple, quick user support for switching between local and host-attached modes. • Support for wide variety of formats with prototype templates.
• Screen, availability, printer, and training problems.	• Larger screen; local processing and storage; and training programs.

The results of the study described here were used to make recommendations on office workstations for the Laboratory and to guide research on office workstations. We now summarize the study and interpret the study results that led to the requirements listed in Table 12.

Two of the study results strongly indicated that an office workstation should conveniently attach to the host (VM/CMS) system. The attachment should be a high-speed one that is at least equal to the 1.2-megabit rate of the display terminals; it should involve a simple hardware and software protocol; it should provide emulation of the display terminal; and it should permit file transfer between host system applications and the workstation. The study indicated a high utilization of and secretarial dependency on host system services such as messages, data bases, and editors. Any workstation that does not provide access to these services would reduce productivity and incur substantial resistance. To ensure transfer of established work patterns, access to the host system should provide the same user interface and functionality as the display terminals, at least as a subset. The study also indicated the importance of the community of users. As observed, this community provides informal training, help, and new applications. If the workstation does not provide access to the shared services, the value of this community of users will be lost.

Adequate host attachment would allow an office workstation to provide the functions of the existing display terminals, but the workstation must also provide the functionality of the typewriter workstations. In particular, the study indicated that the typewriter workstations are used for printing and storage of confidential, short, or personal documents, and for the preparation of documents that are short or difficult to prepare with the display terminal (e.g., forms). Support for document preparation would have to include typewriter

emulation for short documents such as envelopes. One of the advantages of the current typewriter workstation is that it can be used in a standalone mode. Many of the secretaries noted this advantage when asked if they could give up their typewriter workstation. In addition, several secretaries noted that the word processors they had seen did not provide this typewriter capability.

As shown in Table 7, the secretarial personnel work with a wide variety of documents, many of which are prepared, stored, printed, and retrieved using the existing workstations. Thus any new workstation must support these tasks and documents (e.g., letters, memoranda, forms, research reports, and lists). The file transfer capability of the host attachment must be integrated with the local support for these documents so that a document that is prepared at the workstation can be processed by the appropriate host applications. For example, it should be possible to format and print documents prepared at a local workstation with existing host applications. It should also be possible to store in host data bases the forms that are filled in at a workstation. And it should be possible to use the stored content as data inputs to existing accounting applications. A workstation that could support more of the current documents than the existing workstations would be a definite productivity aid, particularly if that support included prototype forms (partially filled in) serving as templates. Finally, the problems with the existing workstations that the secretaries listed indicate requirements for new workstations. Larger screens, smaller packaging, local processing and storage, a high-quality printer, and training programs would be considered advantages.

The study results thus indicated both an opportunity and a set of requirements for an administrative workstation, on the basis of which we were unable to identify an existing product that met these requirements. The requirements that seemed to be the most difficult to meet were the following:

- *Adequate host system attachment.* Most existing workstations do not provide high-speed connection (e.g., one megabit or greater), full-screen display terminal emulation, or file transfer to host application programs (e.g., editors).
- *Multitasking with simple, fast task switch.* In workstations that provide multitasking, the user must take several actions (e.g., go through several menus, load diskettes) in order to switch tasks. The exceptions are workstations that permit multiple display windows, one for each task running in the workstation.
- *Typewriter emulation.* In only a few CRT word processors can a user insert paper, such as an envelope, in the printer and type directly onto the paper without creating a workstation file. In addition, on most workstations it appears difficult to support preprinted forms because of the complicated formats that are typical of these forms.

On the basis of the requirements in this study, the administrative management decided not to replace the existing workstations at this time. In addition, a project in the Computer Science function has begun to do research on extensions to currently available IBM products in order to provide a workstation that meets the requirements.

**comparisons
among
CISR
study
sites**

A few observations on the environment at the San Jose Research Laboratory and its effect on the natural growth in the use of advanced technology may be appropriate here. A secretarial self-selection process appears to be at work. Secretarial applicants are not surprised to be working with computers. Candidates had often been urged to apply by friends who knew their capabilities and who were familiar with the heavy workload, tight deadlines, and little formal training or aid on the job. For those who are willing to seek aid, the Research Staff Members are a source of supportive assistance. The Laboratory work environment has led to a cadre of secretaries who expect to learn new things and who are willing to think creatively.

Although a similarly conducive environment was expected at another high-technology location surveyed by CISR, there were significant differences. There the workload was lighter (one secretary serving one or two other employees), and the secretaries appeared to be less highly motivated. Although there was some latent support for learning new techniques, the professional staff appeared to be less willing to lend assistance when secretaries encountered problems.

At a small consulting firm, each professional and the secretary formed a supportive team working in close relationship. Although the professionals were highly qualified for their jobs, they did not have technical training in the details of the computer system. The secretaries typically worked out system problems in collaboration with the professionals. If a solution was not readily discovered, the professional called the service organization, gleaned what information was available, and then returned to the terminal to work with the secretary. Actually, the professionals were no more qualified in the operation of the system than were the secretaries, but they were typically more aggressive in seeking information from the vendor.

At a fourth location, neither the professional staff nor the secretarial staff was familiar with intricacies of system operation. As a result, the system installed there was used only lightly and very unimaginatively.

All these organizations appeared to be evolving through office technology stages in the same way that organizations move through the following information system technology stages as described by Gibson and Nolan:⁵

Stage 1 Initiation, where a concept is introduced and grows slowly.

- Stage 2* Contagion, where the concept is fully embraced and shows enthusiastic growth.
- Stage 3* Control, where management becomes concerned about unplanned growth and institutes control mechanisms.
- Stage 4* Maturity, where a balance is achieved between satisfying user needs and maintaining reasonable management control.

Many factors combine, including company tradition, environment, industry sector, growth, and available technology. These all influence where on the curve of office technology stages a company presently falls. Zisman² discusses this concept specifically with respect to office automation. Rockart and Flannery⁶ describe it in the area of end-user computing.

We can see the pattern at our research sites; the San Jose Research Laboratory is in the second stage—contagion or expansion. The other sites are still in the first stage—initiation. They are not yet experiencing the enthusiasm that goes along with moving into the second stage.

Discussion

Although the observations and workstation requirements that came out of this study are not necessarily surprising, they are important. The results of the study were the major inputs into the decision to continue using the current workstations and into the enhancements to be made to current IBM products. In addition, the study provided a number of useful insights on administrative functions and the potential for office automation at the San Jose Research Laboratory. We conclude with a discussion of these insights.

We were able to identify missions, functions, procedures, and tasks in offices through the use of the Office Analysis Methodology. The results include classes of work considered both typical and less typical in the secretarial world. The Laboratory environment has provided a good opportunity to observe a natural growth pattern in the use of advanced technology. This gives us an opportunity to "see the future," to glimpse the potential for office automation. Our observation of the workstation features that are used in performing advanced office procedures gives us confidence that our compilation of workstation requirements is responsive to future secretarial needs.

A number of interesting organizational and behavioral implications of office automation have been identified. Perhaps the most significant is the importance of a user community. The willingness to communicate and the technical support for communication enable a group of users to develop applications and share techniques with a minimum of formal programming support. At the San Jose Research

Laboratory one programmer from the Computing Center spends part of his time in work directed to secretarial support. Computer Science Research Staff Members also add capability to the system, but that is not considered to be formal "programmer support."

Another interesting observation is in the area of user resistance. At the San Jose Research Laboratory we did not see a reluctance to use new technology. Obviously the high-technology environment has a significant influence on creating an atmosphere for acceptance. In addition, the secretarial self-selection process plays a role. There appear to be at least two additional factors that contributed to a low resistance to innovation. First, the heavy work load resulting from the ratio of support staff to professional staff creates a situation in which secretaries are highly motivated to enhance their own ability to get the work done. It is clear to everyone at the Laboratory that without the aid supplied through the host system the secretaries would be hopelessly inundated with work. In addition, because the professional staff themselves make use of the computer-based tools, the early rough-draft versions of paperwork are seldom typed directly into the system by the secretaries.

The fact that virtually everyone at the Laboratory has a terminal and that many Research Staff Members do their own text entry suggests that a study should be made of professional staff resistance to personal use of keyboards. Although this matter was not directly investigated in the study reported here, some observations were made as a result of the interviews. The professional staff is enthusiastic and positive about the computer support for self-entry of documents directly into the system. In at least some of the instances where resistance was indicated, it seemed to be based on a sensitivity or insecurity related to the job in general, not to the computer technology. This is an unusual and no doubt controversial observation. Ideas analogous to this have been put forth by Turkle⁷ as she reported the perceptions of data processing professionals when they described their own relationship with computers.

As we stated earlier in this paper, we did not focus on productivity measures. However, secretaries stated that they have found the time to organize tasks and create procedures for smoothing work flow that they could not even think about before. This has been stimulated both by time saved through computer support and by access to the tools powerful enough to create these procedures. Some tasks in this category include automated distribution lists, reminder files triggered by a clock, and financial monitoring and analysis systems. Another stated advantage of the existing office automation tools is the ability of the secretaries to take on new tasks, many of which are self-initiated. Here it is not a case of doing more of the current tasks or of doing them faster, but rather of making use of entirely new functions. A very significant example of a new function is the message system, by which secretaries inform one another when they

will be away from their desks temporarily or arrange for one secretary to do tasks (e.g., pick up printed documents) on behalf of several secretaries.

The results of an Office Analysis Methodology study generally include more detail on procedures and their relationships to the mission of the organization. Such detail can be used to suggest potential or desirable organizational consequences of office automation. Our initial use of the Office Analysis Methodology was for gathering information related to the objectives outlined in the section on the workstation study method earlier in this paper. Thus we did not go into detail on ways in which technology has affected the organization. However, some observations in this area did result from the interviews. First, the use of terminals by professionals to input their draft documents is a consequence of computer-based technology that clearly affects professional work. Also, the ability of the secretary to perform more self-initiated tasks in support of the office mission affects the nature of secretarial work. Finally, the ability of anyone to send electronic messages to anyone, unfettered by traditional office etiquette, creates the potential for a significant simplification of office communications.

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